REMARKS

Applicants appreciate the thorough examination of the present application that is reflected in the nonfinal Official Action of September 19, 2005. In response, independent Claim 17 has been amended to specifically recite a polycrystalline (poly) silicon-germanium layer, to further clarify the patentable distinctions over U.S. Patent 6,479,854 to Thakur et al., taken alone or in combination with U.S. Patent 6,180,480 to Economikos et al. and/or U.S. Patent 6,511,873 to Ballantine et al. The reasons for patentability will be described in detail below.

The Rejections Under 35 USC §112 Have Been Overcome

Claim 27 stands rejected under 35 USC §112 because of the improper claim dependency. Claim 27 has been amended to depend from Claim 18, as suggested by the Examiner. Applicants appreciate the Examiner's pointing out this typographical error. Accordingly, the rejections under 35 USC §112 have been overcome.

Claim 17 Is Patentable Over Thakur et al.

Claim 17 stands rejected under 35 USC §102(b) as being anticipated by Thakur et al. However, Claim 17 has been amended to recite:

> sequentially stacking a metallic layer and a poly$Si_{1-x}Ge_x$ layer on the dielectric layer to form an upper electrode comprising the metallic layer and the poly$Si_{1-x}Ge_x$ layer.

Thakur et al. does not describe or suggest the formation of a polycrystalline silicon-germanium layer on a metallic layer. Nor would the formation of a polycrystalline silicon-germanium layer be inherent or obvious in view of the disclosure of Thakur et al. In particular, as noted in the present application at Page 8, lines 5-7

> However, since the $Si_{1-x}Ge_x$ layer is deposited on the TiN layer 152 which is crystalline, the $Si_{1-x}Ge_x$ layer may become crystalline unless the deposition temperature of the $Si_{1-x}Ge_x$ layer is very low.

Accordingly, Thakur et al. does not explicitly or inherently disclose a polycrystalline silicon-germanium layer, as now recited in independent Claim 17.

Dependent Claims 26 and 28 also were rejected under 35 USC §102(b) as being anticipated by Thakur et al. These claims are patentable at least per the patentability of independent Claim 17, from which they depend.

Claims 18-25, 27 and 29-30 Are Patentable Over Thakur et al. In View of Economikos et al.

Claims 18-25, 27 and 29-30 were rejected under 35 USC §103(a) as being unpatentable over Thakur et al. in view of Economikos et al. In rejecting these claims, the Official Action concedes at Page 4 that:

> In re claim 18, Thakur et al. disclose the method as claimed and rejected above, but does not disclose the method wherein the silicon germanium layer is a doped poly$Si_{1-x}Ge_x$ layer, nor the method of doping.

The Official Action cites Economikos et al. in an attempt to supply the missing teachings.

In this regard, Applicants respectfully wish to point out that it would not be obvious to combine Economikos et al. with Thakur et al., absent the teaching provided by the present application, because Thakur et al. relates to capacitor structures that include a silicon-germanium electrode layer, whereas Economikos et al. describes the use of silicon-germanium to fill deep trenches. Accordingly, there is no motivation to combine Economikos et al. with Thakur et al., absent the disclosure of the present application.

Moreover, even if combined, the temperatures recited in Claims 23, 25 and new dependent Claim 33 are simply not described or suggested in Economikos et al. In particular, in rejecting these claims, the Official Action points to Column 3, line 40-Column 4, line 4 of Economikos et al. However, these temperatures all relate to pure germanium, not to polycrystalline silicon-germanium. In particular, as noted in Economikos et al. Column 3, lines 34-36, the trench fill material **30'** can comprise pure germanium or silicon-germanium alloy. Then, as noted by Economikos et al. Column 3, lines 41-64:

> The germanium or $Si_{1-x}Ge_x$ fill material is typically deposited by a Chemical Vapor Deposition (CVD) process well known in the art. Pure germanium deposition can be achieved using Low Pressure CVD (LPCVD) at a deposition temperature of 350° C. with a GeH_4 partial pressure of 0.2 Pa to 12 Pa to achieve a steady-state deposition rate of 20 Å/min. to 80 Å/min. in either an H_2 or Ar carrier gas in a batch furnace, as described by Kobayashi et al., J. Crystal Growth 174, pp. 686-90 (1997). Other reactive germanium gases or other germanium or $Si_{1-x}Ge_x$, growth processes can be employed. Complete fill is not critical, in this step, because large voids can be tolerated.
>
> The deposition temperature, pressure, and gas flows can be adjusted to tune the process for optimal deposition rate or particulate performance. For reasonable germanium coverage in the trench in a single step, the overall processing range for the LPCVD furnace process is

> generally 300-500° C. at 0.01-30 Pa GeH_4 partial pressure. Deposition at temperatures above 550° C. and as high as 800° C. is possible, but may tend to give less conformal deposition. Although conformal deposition is helpful, it is not necessary because filling the voids is not a requirement at this step in the process according to the present invention. (Emphasis added.)

Later, at Column 4, lines 44-49, deposition of a cap layer of amorphous or polycrystalline silicon is described:

> The deposited cap layer is generally about 300 Å or more thick, sufficient to prevent oxidation of the germanium fill and serve as a diffusion barrier. Preferably, a deposition temperature in the range of 500-550° C. may be used to generate only amorphous silicon and to reduce particle generation. (Emphasis added.)

Accordingly, even if Economikos et al. is combined with Thakur et al., the temperature recitations of Claims 23, 25 and 33 would not be described or suggested. Accordingly, these claims are independently patentable.

Independent Claim 29 also is patentable over Thakur et al. in view of Economikos et al. for the same reasons that were described immediately above. To summarize, Thakur et al. is devoid of any description of forming a silicon-germanium layer at about 550°C or less. Moreover, there is no motivation to combine Economikos et al.'s trench fill silicon-germanium layer into the capacitor electrode layer of Thakur et al. Finally, even if combined, Economikos et al.'s disclosure of temperatures of less than about 550°C are all in connection with pure germanium or pure silicon, not with silicon-germanium. Accordingly, independent Claim 29 is patentable over Thakur et al. in view of Economikos et al. Claim 30 and new dependent Claim 34 are patentable at least per the patentability of Claim 29 from which they depend.

New dependent Claims 31 and 32 are independently patentable for at least the reasons that were described above in connection with Claims 17 and 33. This analysis will not be repeated for the sake of brevity.

Claims 17, 26 and 28 Are Patentable Over U.S. Patent 6,511,873 to Ballantine et al. In View of Thakur et al.

Claims 17, 26 and 28 also stand rejected under 35 USC §103(a) as being unpatentable over Ballantine et al. in view of Thakur et al. The Official Action concedes at Page 7 that:

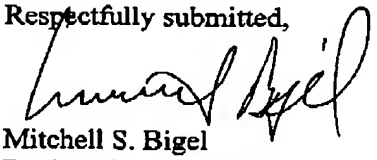
> Ballentine et al. disclose the method of forming the diffusion barrier layer of nitrides, oxides and oxynitride but does note [sic] disclose that the layer is a metallic oxide or nitride.

In an attempt to supply the missing teaching, the Official Action cites Thakur et al. as disclosing metallic oxides or nitrides. However, as was pointed out above in connection with Claim 17, Thakur et al. does not describe polycrystalline silicon-germanium, and the use of a metallic oxide or nitride would produce monocrystalline silicon-germanium rather than polycrystalline silicon-germanium. Accordingly, even if Thakur et al. was substituted into Ballantine et al., the claimed polysilicon-germanium on a metallic layer would not be produced. Claims 26 and 28 are patentable at least per the patentability of Claim 17 from which they depend.

Conclusion

Applicants again appreciate the thorough examination that is evident in the Official Action. However, Applicants have now shown that all of the pending claims are patentable over Thakur et al., taken singly or in combination with Economikos et al. and/or Ballantine et al. Accordingly, Applicants respectfully request withdrawal of the outstanding rejections and allowance of the present application.

Respectfully submitted,



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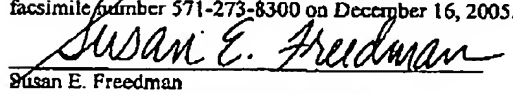

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